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Modern Trends in Management

In an excellent article printed in a service bulletin just issued by the Council of Ironfoundry Associations, the position of the personnel manager *vis à vis* with the departmental superintendent's is well and clearly defined, but this officer is not the only one who can interfere in the conduct of the foundry department. There are the safety first and welfare officers, the production staff, the works cost accountant, the laboratory, the consulting engineer, the works manager, the shop steward, and the directors. There may be others! Fortunately, in most concerns the executive of the foundry department co-operates very satisfactorily with all these people, but there is usually just one that is a nuisance, due in the main to clash of personalities. If it can be taken for granted that the foundry manager, superintendent or foreman is in absolute charge of his department, then it is clear that he has only one chief, either the works manager or the managing director. Trouble usually arises when a man is delegated by either the one or the other of these two officials to carry out some set project. Armed with this delegated authority, things begin to happen which are resented by departmental chiefs. This is sheer bad high level management. The proper action to take is to attach to the staff of the department a person capable of advising the chief in any section in which there is presumed to be a weakness, even though it be for a limited period. This maintains authority, for it is surprising how quickly the men in a department realise that the "boss" has lost some of his authority, and discipline immediately deteriorates. One of the best known foundry managers, who was in charge of one of the largest group of shops in the country, when noticing a moulder doing something inefficiently, would merely remark, "Don't let your foreman see you doing that." Every action he took was to reinforce the authority of those immediately under him, whilst invariably retaining for himself the control which was rightly his.

We fear the modern tendency to superimpose upon the established practice of regimentation in industry, a collection of experts on various phases of manufacture and human relationships, will result in chaos. If it be deemed that a foreman requires a new concept of his duties, then he should be given the opportunity to pursue a course of instruction which is now readily available. We have still to be convinced that the modern manager or foreman's job will be made easier by filching from him his instruments of control. Where experts in costing, human relationships and the like are necessary as in the largest concerns, then the heads of departments should receive written instructions or forms, but on no account should there be any dealings with anybody other than the head of a department unless specifically requested.

The organisation of works councils can be beneficial or detrimental. The former, if the top management does everything possible on every occasion in committee to reinforce the position of foreman. The hearing of disputes between men and the foremen should be ruled out, as one decision adverse to an executive would breed a plethora of cases for the future. Management is the function of the management and cannot be delegated to committees.

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Correspondence

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Mr. T. A McIntyre.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—On April 24 I sent you, for publication in your JOURNAL, a short report on a presentation by members of this Association to Mr. T. A. McIntyre, of Shanks & Company, Limited, who resigned his active connection with that company at the beginning of this year. Unfortunately, in my report, which you were good enough to publish in your issue of May 2, I stated that Mr. McIntyre had resigned his directorship of Shanks & Company, Limited, on the conclusion of 50 years' service.

I have now had my attention drawn to the fact that I was in serious error in stating that Mr. McIntyre had resigned his directorship of Shanks & Company. His resignation was that of his executive position with the company, but he still remains a director of the company. I very much regret my error in this matter, and in order that Mr. McIntyre's friends in the B.B.M.A. and in the bath industry generally may be under no misapprehension, I shall be glad if you can find space to publish this correction.—Yours, etc.,

W. R. BLAIR,
Chairman.

British Bath Manufacturers' Association, Limited,
145, St. Vincent Street, Glasgow, C.2.
July 14, 1947.

Pari-Blast Cupola

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—The writer has intended for some time to deal with one or two points raised in Mr. Tucker's admirable Paper which was reprinted in FOUNDRY TRADE JOURNAL dated May 22.

Mr. Tucker mentioned that it had not been definitely established that best results were obtained by equalising the air value to each tuyere. While it is true that intensive experiments with unbalanced tuyeres have not been conducted with this design of cupola, the following facts should be noted.

Pari-Blast cupola owes its inception largely due to the troubles experienced with cupolas having no controlled tuyere balance. If a Pari-Blast cupola is allowed to go out of balance, the old phenomena of one-sided wall destruction and slagging occur.

The melting zone becomes eccentric, so that some parts of the charge are subjected to greater heat than others.

From simple observations such as these, there is a good case for balanced tuyeres. It is customary at the Idoson Motor Cylinder Company, Limited, to hold tuyere balance within 1½ to 3 per cent., and the constancy of melting practice so obtained is highly desirable.

With regard to the initial cost of modification to Pari-Blast design, considerable thought was given to the method of signalling tuyere flow and pressure measurements. One idea was a system of "traffic lights"; another was a single volume and pressure indicator with switch, such as Mr. Tucker suggests. The defect of the latter is that one must rely on the operator to make periodical manipulations of the switch, and experience has shown that the human element plays an adverse part.

A defect common to both of these ideas is that the relative performance of each tuyere cannot be observed easily, and it is rather like spoiling the ship for a ha'porth of tar to try to economise by using insufficient instruments. The standard practice is to fit one instrument per tuyere, the instruments being arranged side by side and located where they are readily visible to the operator. If slagging of one tuyere should occur, the trouble is immediately located by the cupola man by a glance at the instruments. If he was supplied with only one instrument, the chances are that it would be left switched on to a tuyere which was not giving trouble. The point to bear in mind about these instruments is that they are giving continuous indication of the cupola performance, and that they indicate where attention should be given. Such attention may be called for two or three times in the course of an hour if the melt is being maintained at high standard conditions. It is quite conceivable that a trouble may be averted because of its immediate reaction in the instruments, thus well justifying the initial instrument cost.—Yours, etc.,

For Metronic Instrument Company, Limited,
H. A. HALLETT.

196, Grove Lane,
Smethwick, 40, Staffs.
July 15, 1947.

Nickel in R.M.S. "Queen Elizabeth"

A 32-page well-illustrated brochure has just been issued by the Mond Nickel Company, Limited, Grosvenor House, Park Lane, London, W.1, covering the widespread use of nickel and its alloys in the "Queen Elizabeth." Both the engineering and decorative uses are included, the latter having stood up particularly well to the rough usage of the war years.

German Industrial Reports

Two reports of interest to our readers are now available from H.M. Stationery Office, Kingsway, London, W.C.2, and elsewhere. They are "German Propellers for Aircraft and Marine Craft" (B.I.O.S. 1337, price 1s. 1d.) and "Aspects of German Foundry Practice" (B.I.O.S. 1354, price 3s. 8d. post free).

THE RESULT of the offer by Rahon Steel, Limited, for the ordinary share capital of Darwins, Limited, steelmakers, of Sheffield, shows acceptances by the holders of 907,000 shares. This will give Rahon Steel, Limited, an 86 per cent. holding of the issued equity capital of £514,150 in 1,028,300 10s. shares.

Principles of Precision Investment Casting*

Part II

By Kenneth Geist† and Robert M. Kerr, Jr.‡

It is highly important that the physical properties of the investment being used is thoroughly understood, because not only are the tolerances affected but many defects in the casting are caused by improper handling of the flask. In Fig. 21 are shown expansion curves for two low temperature non-ferrous investments both having high expansion qualities. If one should choose a mould temperature of 205 deg. on the cristobalite curve, there would be an expansion of 0.35 per cent. Now, if by some mistake or failure in the controls, the moulds were heated to 295 deg. C., there would be an expansion of 1.25 per cent., or an increase in expansion of 0.90 per cent.

On the other hand, if one were to choose a mould temperature of 705 deg. C., there would be an expansion of 1.3 per cent. If, by a similar mistake, one heated the mould to 785 deg. C., one would only have a change in expansion of about 0.02 of 1 per cent. Obviously, in the production setup, good results could not be obtained in the temperature ranges where the expansion curve is rising rapidly. A flat section of the curve should be chosen. This is also advantageous because it is sometimes necessary to hold the mould at casting temperature for longer periods than scheduled, due to mechanical trouble in the casting process. If the curve be flat, there is little danger from prolonged heating.

The rapidly rising expansion curve points out another danger which must be avoided; namely, too rapid an increase in temperature. Since nearly all the investment compounds are poor conductors there would, of necessity, be a very steep temperature gradient between the outside and the centre of the moulds during rapid heating. Hence, due to the rapid changes in expansion, there would be stresses set up in the investment which would tend to crack and warp the mould. There is also the possibility of generating steam faster than it can escape, resulting in spalled surfaces due to excessive steam pressure.

The above properties were those of a non-ferrous investment, but the principles apply to all the investments. The expansion curves are all quite similar (see Fig. 22). Those investments having silica base refractories have the added hazard of inversion points through which the heating rate must be slow. The magnesia or zirconia base refractories do not have these inversion points.

Various formulæ for investments and binders are set out in Table I.

6. *Wax Elimination.*

Subsequent to the investing operation and prior to firing, most of the wax is eliminated from the mould by any one of several methods. Those investments containing water as a carrier can be placed in a low temperature circulating air oven. Those investments containing inflammable carriers such as alcohol should be dewaxed by a low pressure steam jet applied to the wax sprue. It is quite important to eliminate a good portion of the wax before firing because the wax usually expands more than the investment, and hence, when it soaks into the investment it can generate enough pressure to crack or spall the mould or cause the surfaces to buckle.

TABLE I—*Investment Formulæ.*

No. 18[3]	*Per cent.*
Plaster of Paris	30·0
Silex (powdered)	70·0
No. 38	
Plaster of Paris	50·0
Powdered mica	25·0
Marble dust	25·0
No. 510	
Plaster of Paris	30·0
Cristobalite	50·0
Tridymite (and silica)	20·0
No. 713	
Calcined gypsum	80·0
Asbestos fibre	20·0
No. 916	
Silica	67·0
Liquid:	
Tetraethyl silicate (8 vol)	
Water (1 vol.)	
Alcohol (1–2 vol.)	33·0
Hydrochloric acid (few drops)	

No. 28[3]	*Per cent.*
Plaster of Paris	52·0
Marble dust	16·0
Graphite	16·0
Soapstone (powdered)	16·0
No. 49	
Alpha gypsum (21)	30·0
Silica (200–400 mesh)	62·0
Andalusite (fine)	5·0
Alumdum (fine)	1·0
Boric acid	2·0
No. 611	
Calcined gypsum	30·0
Silica	69·0
Strontium chloride	1·0
No. 814	
Plaster of Paris	60·0
Silica	25·0
Talc	15·0
No. 1017	
Silica	90·0
Magnesia	6·0
Monobasic ammonium phosphate	3·0
Monobasic sodium phosphate	1·0
Liquid—water or 10 per cent. hydrochloric or nitric acid	

NOTES: Numbers of above formulæ refer to type.
Formulæ 1 to 3 are old types of dental investment of low expansion
Formulæ 4 to 6 are new types dental investment of high expansion
Formulæ 7 and 8 are mixtures for plaster casting. Formulæ 9 and 10 are investments for stainless high fusing alloys.

7. *Firing the Mould.*

There are several reasons why the mould is fired. First is to eliminate the last vestiges of the expendable pattern, either wax, plastic, or metal. There is always some wax left in the mould after it has come off the steam tables or out of the low temperature oven. This can only be eliminated by burning completely, which is difficult to do on a production basis at less than 650 deg. C.

*Exchange Paper of the American Foundrymen's Association, presented at the 44th Annual Conference of the Institute of British Foundrymen at Nottingham, June 19.

†Technical engineer in charge of precision casting at Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin.
‡President, Kerr Manufacturing Company, Detroit, Michigan.

Precision Investment Casting

The second reason is to provide a hot mould so that the metal will run into all the farthermost corners. Since many pieces cast have very thin webs or fine detail, the mould must provide every advantage for the metal to run.

The third reason is that part of the linear shrinkage of the metal and wax can be compensated for by the expansion of the investment. As a matter of fact, some investments are compounded so that minor

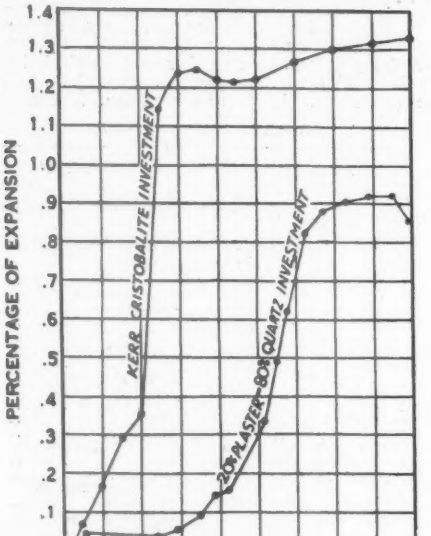


FIG. 21.—COMPARATIVE THERMAL EXPANSIONS, KERR CRYSTOBALITE INLAY INVESTMENT AND ORDINARY HIGH EXPANDING INVESTMENT.

dimensional errors may be corrected by varying the mould temperature.

There are two general methods for firing the mould. The first is the batch type of furnace. Batch furnaces are quite versatile since the heating cycle can be varied quite easily to suit the particular mould. They must be cooled down to 90 to 150 deg. C. each time they are loaded, hence considerable time and fuel is wasted in heating and cooling the furnace. The refractory life is less, too, because of the temperature variations. these furnaces may be heated by gas, oil, or electricity.

The second method is the continuous or pusher type furnace. This is the ideal production furnace if

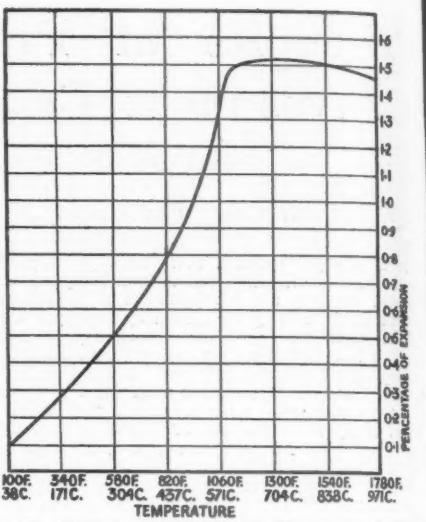


FIG. 22.—THERMAL EXPANSION OF FERROLITE INVESTMENT. FOR FERROUS AND HIGH-TEMPERATURE ALLOYS.

the sizes of the moulds do not vary too much. If production is sufficiently high this furnace will operate 24 hours a day with no loss of time for cooling or loading. The cold moulds are loaded at one end, progress through the furnace in 3 to 5 hours, and emerge at casting temperature. The big disadvantage of this furnace is that it cannot handle mixed moulds varying greatly in size, because the heating cycle cannot be varied easily. It is obvious that it requires more time to raise an 8-in. square mould to 980 deg. C. than it does a 4-in. square mould. Hence, the most ideal setup for a production shop would be a pusher type furnace with two or three batch furnaces as auxiliaries.

Fig. 23 shows a gas fired pusher type furnace used very successfully. The pushing arm is pneumatically operated. Fig. 24 shows a specialised type of furnace which is of the conveyor type except the small sizes of moulds allow the operator to push them through.

When the moulds are up to temperature they should be cast immediately upon removal from the furnace. Fig. 25 illustrates the difference in temperature between the centre and ½ in. from the surface of the mould during an interval of 8 minutes' exposure to the air. Recalling the results obtained by too rapid heating during the rapid expansion stage of the cycle, the same results can be obtained through rapid cooling. Stresses are set up due to the contraction of the outer portion of the mould resulting in cracking of spalling. Hence it is important to cast within a minute or two after removal from the furnace.

FIG. 23.—PREHEATING FURNACES.

There are some instances, however, when it is necessary to cool the mould to a lower temperature. Some of the non-ferrous metals cannot be poured at high temperatures, so that it may be necessary to cool the mould to less than 205 deg. C. In this case, due allowance must be made for the shrinkage by cooling the mould slowly to reduce the temperature gradient as much as possible.

8. *Melting and Casting.*

The earliest castings of the dental industry were made by melting with a blow pipe. Many dental and some jewellery castings are still made this way. Fig. 26 illustrates the blow pipe type of melting, using a dental type centrifugal casting machine. This melting is good only for a very small melt and for metals which dc not readily pick up gases from the flame.

Actually, the metal can be melted in any one of these conventional methods, or in any of the specialised melting machines, developed for this industry. Fig. 27 shows crucible melting which may be done in either gas or electric furnaces. In this case the metal is poured from the crucible either into the mould or into the casting machine. Fig. 28 shows melting by high frequency. This, of course, has the advantage of accurate control and high temperature metals can easily be melted. In any method of melting, good metallurgical procedure should always be followed, such as control of atmosphere, introduction of inert gases, and other recognised good procedure.

The actual casting of the mould varies very greatly from shop to shop. In some cases the moulds are poured statically; in other instances centrifugal casting machines, air pressure machines, or vacuum machines are used. The first dental castings were made in pressure machines; by pressure is meant air or gas pressures. Fig. 29 shows an air pressure machine with an air tank on the bottom, and a hand pump for pumping up the pressure. About 40 lbs. per sq. inch was produced by this machine.

The mould is placed upright on the platform, metal melted on top of the investment, and machine closed, causing the cap to seal on top of the flask, at the same time allowing the valve to open allowing the air pressure to act on the molten metal forcing it into the mould.

Fig. 30 shows another type of air pressure machine using air directly from the air line, giving up to 100 lbs. per sq. inch pressure. The machine is a little more automatic in operation. As soon as the metal is melted, the arm is swung over to automatically drop the cap into position, opening the air valve.

Of course, in any type of pressure machine, a good seal must be maintained between the flask and the source of pressure, and in large diameter moulds, this seal is a problem, because as the area increases, the amount of force necessary to keep the cap clamped on to the flask also increases, and very high pressures may be necessary. For this reason, in large castings, only a very low gas pressure is used.

Fig. 31 shows another type of machine using air pressure. In this case the metal is melted in the crucible, completely enclosed and melted by an arc. A small opening leads to the top of the enclosure

FIG. 24.—PUSH THROUGH TUBE FURNACE.

Precision Investment Casting

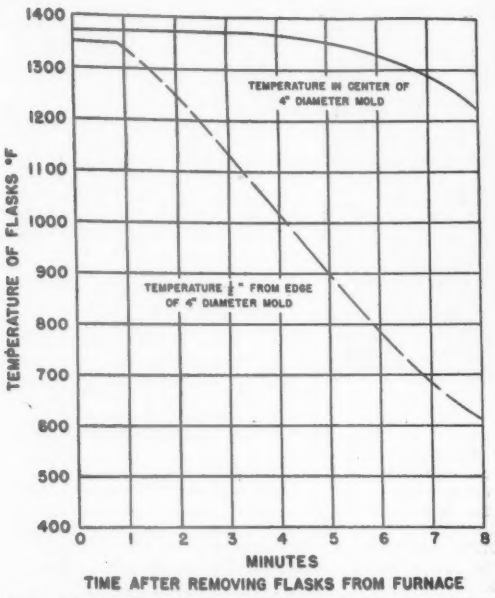


FIG. 25.—TEMPERATURE DECREASE IN KERR CASTING FLASKS UPON REMOVAL FROM FURNACE.

FIG. 26.—BLOW-PIPE TYPE OF MELTING.

FIG. 27.—CRUCIBLE MELTING.

FIG. 28.—CASTING FROM ELECTRIC FURNACE.

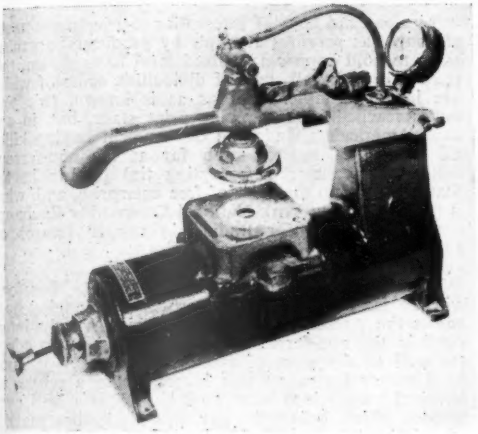


FIG. 29.—AIR PRESSURE MACHINE.

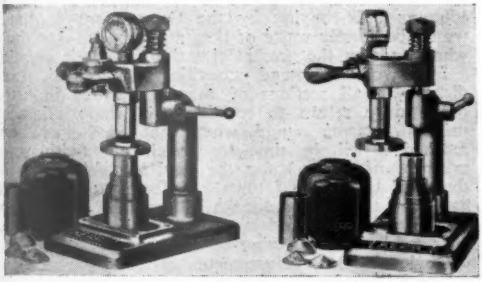


FIG. 30.—SECOND TYPE OF AIR PRESSURE MACHINE.

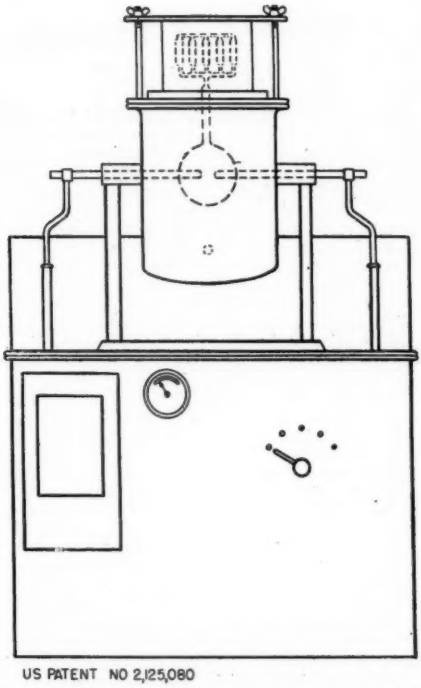


FIG. 31.—A THIRD TYPE OF AIR PRESSURE MACHINE.

and the mould is clamped in an inverted position at the top of the enclosed crucible. When the metal is melted, the whole device is inverted, the metal runs down the small lead to the mould and air or gas pressure is introduced behind the metal completing the casting. Three to fifty pounds would probably be the maximum amount of pressure used in this type of machine.

(To be continued.)

House Organ

Alloy Metals Review, Vol. 5, No. 44. Issued by High Speed Steel Alloys, Limited, Widnes, Lancs.

This issue gives a report of some investigations on the properties of low-carbon steels containing over 1 per cent. molybdenum. Hardenability, for example, is found to be retarded. Mention is made of tests on a 3 per cent. Mo composition for a mould for a cast-iron pipe, it being estimated that these 3 per cent. Mo steels will give at least 75 per cent. more service than the Cr-Mo (S.A.E. 4130) moulds.

New Catalogue

Silicon Iron.—The acid-resisting "Hypersilid" of Bradley & Foster, Limited, Darlaston, Staffs., is described in a 46-page handbook. The object of this very useful publication is to provide data of value to designers, drawing office staff and others to whom a knowledge of the properties of acid-resisting silicon irons is of interest and importance. The main section of the book deals with physical, mechanical and corrosion properties, supplemented by practical notes on the manufacture of alloy castings.

Wanted, a Lifebelt

By "Onlooker"

The dictionary defines the lifebelt as "something to keep a person afloat," and it would be hard to beat this simple and all-embracive description. During the past few weeks, when those engaged in the non-ferrous metal industry have seen the first unmistakable signs of a break-up of the price structure, many pairs of eyes (in a mental sense) have been casting anxious glances far and near for a plank to which they could cling in the storm which seemed ready to burst upon them. A change of heart is not easy to achieve, and after nearly seven years of bullish sentiment the mind boggles at switching over to the sentiment implicit in a downward price trend. Yet, surely, it must have been realised all along that some day a turn round of this kind would come! Undoubtedly close students of the non-ferrous metal situation knew very well that the inflationary spirit which had seized upon copper, lead, zinc and tin would eventually result in the prices boiling over and bringing about a collapse. From time to time one heard voices raised in favour of a return to the principle of free marketing, but the Government appeared to have nailed its colours to the bulk purchasing mast and they received plenty of support from people in the trade. For this there was perhaps good reason, since during the war and for some months thereafter the Ministry of Supply was able to maintain the non-ferrous metal quotations at the levels fixed in December, 1939. That these were essentially reasonable cannot be gainsaid, but unfortunately the authorities entirely misjudged the trend of world markets and held on to their selling limits too long.

A Transitory Advantage

But the relatively low prices maintained in the face of an unprecedented world demand were not the only assets prized by the consumers in the wartime set-up; what they valued probably much more was the achievement of absolute stability. It was argued at the time, it would seem with more enthusiasm than intelligence, that this agreeable state of affairs could endure indefinitely and objections raised by the economists were voted out of order. Those who ventured to advance the claims of the commodity markets were sent to the right-about and their ideas dismissed as altogether out of date. In short, the millenium in the shape of bulk purchasing had arrived! The intention underlying the desire for an unchanging value in a commodity is altogether admirable, for it dismisses at a stroke the speculative element, cuts out the risk of loss on stock from a depreciating price and enables the manufacturer to concentrate his attention upon the problems attaching to production. No wonder, then, that the period of the war, when, as one order was completed another took its place, is counted in some respects as a time free from many anxieties which have since begun to bear heavily on industrial undertakings. It may be that something might have been done along the lines of international price agreements, although, as previous attempts by producers' organisations to hold copper at a fixed level have shown, this road is beset by all sorts of difficulties, some of which are insurmountable. So far as is known, this plan never reached even the blue print stage, but, in any case, America's abandoning Government buying killed all chance of success. So far as the non-ferrous metals are concerned (excepting tin) trading in the States is now on the basis of free enterprise, and, what is more, the New York National Commodity Exchange opened its doors for trading in copper futures on July 15.

New York the New Centre

Those who are looking for a lifebelt, therefore, will, so far as copper is concerned, cast longing eyes across the Atlantic to a country which, vitally interested in the non-ferrous metals, has decided to adopt the well tried system of trading in futures. It must be a matter for regret that in respect of a return to terminal transactions New York has taken a lead over London which, before the war, was the leading market of this kind in the world. But those who are now crying out for a chance to protect themselves against the dangers inherent in a bear market should note that the Americans have waited for more than half a year after the withdrawal of the Government from the sphere of trading in copper to make a beginning on a warrant market. The moral of this is plain enough. To throw open the doors in Whittington Avenue so long as bulk buying by the Government continues would be merely waste of time and money. Let those who condemn the present situation, which is creating a feeling of widespread uncertainty, apprehension and distrust in all sections of the non-ferrous industry, press for a return to conditions of importation by private enterprise, and when that goal has been reached it will be time to stretch out (with some prospect of success) for the coveted lifebelt in the shape of trading in futures. Unfortunately, no heed has been taken in authoritative quarters of the approaching stream, and now that it is upon us the distress signals are flying in vain.

Obviously the Government cannot abandon its responsibility for keeping the country supplied with non-ferrous metals at five minutes' notice, for the change-over is going to take some arranging. What is, of course, required is a frank statement of policy by the Minister of Supply, who would, presumably, take council with the Chancellor of the Exchequer and the President of the Board of Trade before speaking. Whatever course the Cabinet means to pursue, representatives of the industry should be called together in order that the pros and cons of the present admittedly unsatisfactory situation can be discussed. There is a wealth of knowledge and experience on all aspects of the non-ferrous trade available in this country and there seems to be no sense in not making use of it. Our admirable Civil Service is staggering under a great burden of responsibility to-day, and in the direction of provisioning the non-ferrous metal industry their task could be made easier. The time for action has arrived.

Production of Carbon and Alloy Steels by the Side Blown Converter Process

*By F. Cousans**

The last few years have witnessed a marked revival of interest in the side blown converter method of steel making, and much research and development work has been carried out. In the years just prior to the recent war, steel founders in the United Kingdom were able, because of the improved financial position resulting from better trade, to give special attention to the equipment of their foundries. Several steel foundries replaced their old side blown converters with better plant of modern design and construction, and thought was given to possible improvements in operating technique. Little reliable information on the side blown converter process was to be found in the technical press, and so in consequence a fresh approach was made. A serious shortage of hematite pig iron and the necessity for the utmost economy in the use of imported ferro silicon during the recent war stimulated more general interest by all converter users in the possible improvements and economies in operation. The use of the immersion pyrometer for the determination of the bath temperature of liquid steel has proved to be of great assistance in the recent development work.

Production of Molten Metal for Subsequent Conversion

Hot molten metal of regular chemical composition is essential for the successful production of steel by the side blown converter process. The cupola is the normal melting unit employed, and in a general way the melting practice calls for little comment. The cupola charge normally consists of hematite pig iron and steel scrap, and a scrap content of 60 per cent. was, until recently, looked upon as a good figure, but now figures of 80 per cent. or even of 100 per cent. (where the plant is suitable) are being obtained. Where high scrap charges are used, it is desirable to deepen the well of the cupola in order that an adequate carbon content of metal is obtained, the need for a high carbon content will be explained later. Higher sulphurs may result from a deepening of the well, but this can be remedied by desulphurising by the sodium carbonate process. Double desulphurising reduces the sulphur content to very low limits, and figures of 0.010 to 0.015 per cent. have been obtained in this way. The normal silicon of cupola melted metal for converter use is approximately 1.5 per cent., but recent research has demonstrated that a much lower figure can be worked to with very satisfactory results.

For many years Mr. P. C. Fassotte (who is well known amongst American and British steel founders) has stressed the importance of carbon in obtaining a satisfactory temperature increment during conversion of metal into steel in the side blown Bessemer process, and during the last war important plants were laid down in Great Britain which made use of this important function of carbon. Steel scrap charges were melted in cupolas, and the extremely low silicon molten metal after desulphurisation was transferred to pulverised coal fired rotary furnaces. The metal was super-heated to approximately 1,500 deg. C. and was then transferred to side blown converters. The resultant blows gave satisfactory temperature increments and the steel produced was of very high quality and fluidity and was suitable for the mass production of light thin wall steel castings.

The Conversion Process

In the orthodox operation, molten metal at a temperature of 1,250 to 1,350 deg. C. containing approximately C 3.00 to 3.50, Si 1.50, Mn 0.50 per cent. is used in the converter. The oxygen of the blast, which impinges on the surface of the metal, reacts with the metal according to the laws of (*a*) mass and (*b*) chemical affinity. As soon as the blast is put on, heavy brown fumes of iron oxide are seen leaving the mouth of the converter along with metal projections. The iron oxide formed on the surface of the metal then reacts with silicon, manganese and carbon according to their relative chemical affinities at the temperature prevailing. The slag which is first formed is high in iron oxide, but it becomes increasingly silicious as the blow proceeds, and the iron oxide FeO in the slag at the end of the blow is generally within the range 20 to 25 per cent. The normal blow lasts 15 to 18 minutes. In the case of the Fassotte operation which only lasts 9 to 12 minutes, the molten metal at a temperature of 1,450 to 1,500 deg. C. and containing C 3.00, Si 2.4, Mn 0.50 per cent., reacts immediately with the oxygen of the blast forming excess iron oxide which escapes as fume, the remainder reacting immediately with the carbon. The small percentage of silicon present is insufficient to provide silicon to form a slag, and unless precautions are taken the free iron oxide rapidly attacks the converter lining materials. Silica sand thrown on to the surface of the metal prior to putting on the blast provides the free iron oxide with silica with which to combine.

The temperature increment obtained from a normal blow (1.5 per cent. silicon metal) is generally 350 to 450 deg. C., whereas in the case of the very low silicon iron it generally averages 200 deg. C. It is obvious that the modified blowing procedure using superheated low silicon metal is more economical owing to the saving in silicon, in the duration of the blows and in lower chemical and mechanical losses. For plant reasons many founders are unable to take advantage

* Hadfields, Limited, Sheffield. This Paper was selected by the Institute of British Foundrymen as the official exchange paper to the American Foundrymen's Association for 1947. It was also presented to the Nottingham Conference.

Production of Carbon and Alloy Steels

of these potential savings, but it has been found possible even when using ordinary cupola melted metal to work with lower silicons in the metal than are generally used and still produce hot fluid steel of high quality. In the case of cupola melted metal poured to and in the converter at a temperature of 1,250 to 1,350 deg. C., it would appear that the function of the silicon is that of a kindling agent, the heat produced by its oxidation raises the bath temperature to that at which the carbon reaction commences. It therefore needs to be determined what percentage of silicon is essential to give the temperature increment necessary to allow the carbon reactions to proceed. The results of the following experiment may be of assistance in this connection.

A blow of 48 cwt. was stopped after 8 minutes blowing and the changes in the chemical composition and of temperature were noted. The heat was poured into a ladle and allowed to cool to 1,460 deg. C. The metal, after a slagging, was poured back into the vessel and the blow recommenced. The bath lit off immediately, blew steadily and finished in a normal manner. The heat was slagged, the ferro alloys were added and poured into a stoppered ladle and the steel cast quite satisfactorily. The chemical changes are shown in Table I.

TABLE I.—*Chemical Changes in Experimental Blow.* (*Per cent.*)

	C.	Si.	S.	P.	Mn.
Metal in vessel	3.16	1·03	0·034	0·033	0·43
Metal after 8 minutes blow ..	2.56	0·14	0·033	0.035	0.14
Losses	0.60	0.89	—	—	0.29
	(Increase in temperature, 195 deg. C.)				
Metal poured to vessel and blow recommenced	2.56	0.14	0.033	0.035	0.14
End of blow 3 minutes later ..	0.08	0.05	—	—	0.04
Losses	2.48	0.09	—	—	0.10
	(Increase in temperature, 180 deg. C.)				

It will be seen that in general terms and under the conditions of the experiment, the oxidation of 0.90 per cent. silicon, etc., gave an initial temperature increment of 190 to 200 deg. C., and from 2.50 per cent. carbon a further increment of 180 deg. C. was obtained. The reason why the qualification "under the conditions of the experiment" has been made is that the test was made in a plant where the volume of air/minute to the converter was less than is generally used. It was found possible to check over these results in a different plant and in a modified form. A series of heats was blown in an acid lined side blown converter and the metal and temperature changes were noted. A fresh series was blown for 3 minutes and the original metal composition and temperature together with slag and metal compositions and bath temperature after the 3 minutes blow were noted. A further series was blown for 6 minutes and similar data were obtained. A series of 9 and 12 minutes and end of blow determinations were also made. A study of the data obtained reveals the general information shown in Table II.

It will be noted that the rate of temperature charge is highest during the second three minutes of the blows and thereafter tends to fall off rather sharply. The rate of oxidation of silicon is reasonably uniform over the first six minutes, whereas the rate of oxidation of carbon is highest at about 9 minutes of blowing. Heats of metal of the chemical composition and weight given above generally finish in approximately 15 minutes' blowing time and during the blows a temperature increment of 360 to 370 deg. C. is obtained.

TABLE II.—*Second Experiment.*

Weight of metal blown : 45 cwt. approx.

Initial composition of metal blown : C 3.00 to 3.20 ; Si 0.70 to 0.90 Mn 0.40 to 0.60.

Temperature of bath, 1,240 to 1,280 deg. C.

After 3 minutes blowing : 2,500 cub. ft. free air per min. approx.
Composition of metal : C 3.00 to 3.30 ; Si 0.35 to 0.40 ; Mn 0.25 to 0.30.
Composition of slag : SiO_2 37 to 47 per cent. ; FeO 40 to 45 per cent. MnO 9 to 12 per cent.

Temperature increment : 80 to 105 deg. C.

After 6 minutes blowing : 2,000 cub. ft. free air per min. approx.
Composition of metal : C 2.60 to 2.70 ; Si 0.10 to 0.15 ; Mn 0.07 to 0.10.
Composition of slag : SiO_2 35 to 40 per cent. ; FeO 42 to 46 per cent. ; MnO 9 to 11 per cent.

Temperature increment : 250 to 260 deg. C.

After 9 minutes blowing : 2,500 cub. ft. of free air per min. approx.
Composition of metal : C 1.50 to 1.70 ; Si 0.05 to 0.10 ; Mn 0.04 to 0.08.
Composition of slag : SiO_2 50 to 55 per cent. FeO ; 30 to 35 per cent. MnO 10 to 11 per cent.

Temperature increment : 275 to 305 deg. C.

After 12 minutes blowing : 2,000 cub. ft. of free air per minute.
Composition of metal : C 1.15 to 1.35 ; Si 0.05 to 0.10 ; Mn 0.03 to 0.08.
Composition of slag : SiO_2 54 to 58 per cent. ; FeO 26 to 30 per cent. ; MnO 9 to 11 per cent.

Temperature increment : 315 to 330 deg. C.

A study of the foregoing results again demonstrates the economy in the use of silicon and of reduction in blowing time that can be effected if cupola metal of high initial temperature be used, and the results also demonstrate that lower silicons in the bath than are generally used can give good temperature increments.

It should be the aim of side blown converter users to bring down metal in the cupola of standard chemical composition and of as high a temperature as possible. If the metal temperature be determined by means of an immersion pyrometer it should be possible, knowing the chemical composition of the metal, to predict the final bath temperature at the completion of the blow. This makes possible the production of standard temperature steel by the side-blown converter process. If it should be necessary to obtain temperature increments higher than normal, controlled additions of ferro silicon (based on metal composition and weight) can be made during the correct part of the blow, or by addition to the bath prior to putting on the blast.

Photo-electric Cell Control

During the last few years efforts have been made to use photo-electric cell control units to determine the end point of heats made by the side blown converter process.[2] The quality of product made by the process depends broadly upon two factors—the working tem-

perature and of the skill of the operator in turning heats down at the correct time. If heats be turned down too early incorrect carbon results may be obtained, and if too late excessive losses of ferro alloys occur during deoxidation. A series of heats were blown and the end point of the heats was determined by a photo-electric cell with a series of filters. A statistical study of the carbons in the blown metals was made and it can be stated that the use of photo-electric cell control offers distinct possibilities of success in giving uniform chemical composition in the bath at the end of the blow. The British Iron and Steel Research Association have a comprehensive programme of work in hand in this connection.

There are also indications that there is a relationship between the bath temperature and the intensity of the flame. It has been found necessary in connection with this investigation to maintain a close control over the size of the vessel mouth and within the range of bath temperatures 1,640 to 1,700 deg. C. (immersion readings) the cell fitted with a red filter has given deflection readings 2.1 to 3.1 and on plotting the results almost a straight line relationship has been noted. The work should of course be continued with a complete range of filters and it is hoped, in due course, to submit further details of the results.

Degree of Control

The side-blown converter process is capable of producing regularly heats of steel of uniform chemical composition, temperature and fluidity. Statistical studies of the chemical analysis of steel made by this process have demonstrated that, as far as carbon content is concerned, it is possible to obtain as uniform results as those of any other steel-making process. Figures for silicon and manganese are not as good unless the slag formed as the result of the conversion operation is removed before the alloys are added. It is realised that the slagging operation is an additional one, but, bearing in mind the economy in the use of ferro alloys for deoxidation when this is done, the extra work is fully justified.

Heats of steel which have been so handled reveal very close control over silicon and manganese contents in the finished product. It is, of course, essential to weigh all metal prior to charging to the converter, and it is desirable to weigh all liquid steel produced. This gives a clear picture of blowing losses, and in this connection of from 7.0 to 8.0 per cent. are being obtained regularly. In considering this problem of losses it is necessary to have regard to the causes (*a*) chemical and (*b*) mechanical. With cupola metal of C 3.0, Si 0.8 and Mn 0.5 per cent., there is a chemical loss of 4.3 per cent. without taking losses of iron due to oxidation into account.

If hot metal be used the use of low silicon iron helps to reduce to a minimum the chemical losses. The design of the converter has an important bearing upon the problem of mechanical losses. Experience has shown that a long converter body with a small mouth helps to keep the mechanical losses down to a low figure. Some of the metal which might be projected from the converter as the result of the impingement of the blast upon the metal surface falls back inside the vessel if a small mouth be used. In blowing low silicon irons it has been found advantageous to add silica sand on the metal surface prior to putting on the blast, to protect the vessel lining against the attack of iron oxide, etc. This point has been mentioned earlier but in view of its value it is again stressed.

Quality of Product

The quality of steel made by the acid side-blown converter can be much higher than is generally appreciated. The possible regularity and uniformity of chemical composition has already been mentioned. The cleanliness and low gas contents are other factors which ought to be stressed. Eight heats of steel show the chemical analyses and inclusion counts set out in Table III.

TABLE III.—*Composition and Inclusion Counts of the Converter Steel. (Per cent.)*

	1.	2.	3.	4.	5.	6.	7.	8.
Chemical Analyses :								
C	0.225	0.20	0.21	0.20	0.20	0.20	0.215	0.20
Si	0.37	0.33	0.38	0.34	0.38	0.35	0.38	0.36
Mn	0.94	0 86	0 90	0 85	0 99	0.86	0.82	0.85
S	0.036	0.033	0.035	0.042	0.029	0.037	0.034	0.028
P	0.043	0.045	0.042	0.042	0.042	0.051	0.040	0.041
Inclusion Counts (Fox method) :	88	78	72	87	67	85	77	75

TABLE IV.—*Gas Analyses of Converter Steel.*

Cupola metal before desulphurising :			
	Per cent.	Per cent.	
C ..	2.99	2.94	
Si ..	1.08	1.05	
Mn	0.67	0.68	
S ..	0.084	0.090	Temperature of metal, 1,340 deg. C. by the immersion pyrometer.
P ..	0.043	0.042	
O ..	0.006	0.014	
H ..	0.0002	0.0006	
N ..	0.009	0.008	
Cupola metal after desulphurising :			
	Per cent.	Per cent.	
C ..	3.13	3.08	
Si ..	0.82	0.81	
Mn	0.61	0.61	
S ..	0.057	0.041	Temperature of metal, 1,267 deg. C. by the immersion pyrometer.
P ..	0.042	0.042	
O ..	0.0025	0.003	
N ..	0.004	0.004	
H ..	0.00005	0.00005	
Blown metal :			
	Per cent.	Per cent.	
C ..	0.08	0.07	
Si ..	0.03	0.04	
Mn	0.12	0.08	
S ..	0.037	0.041	Temperature of blown metal, 1,682 deg. C. by the immersion pyrometer.
P ..	0.039	0.042	
O ..	0.035	0.050	
H ..	0.0007	0.0007	
N ..	0.010	0.009	
Final steel :			
	Per cent.	Per cent.	Per cent.	
C ..	0.25	0.24	0.24	
Si	0.36	0.36	0.36	
Mn	1.52	1.52	1.52	Temperature of steel in ladle, 1,562 deg. C. by the immersion pyrometer.
S ..	0.047	0.044	0.047	
P ..	0.048	0.047	0.053	
O ..	0.0025	0.0025	0.0025	
H	0.00015	0.00015	0.00015	
N	0.005	0.005	0.005	

The analyses (Table IV) of samples taken during a

Production of Carbon and Carbon Steels

heat of steel will support the claim that the steel compares favourably with that made by other processes as far as gas content is concerned, and will be of interest as indicating the changes in gas content which occur during the conversion process.

Physical and Mechanical Properties

The side blown converter process is ideal for the production of carbon steels of any carbon content. Liquid cupola metal can be used to recarburise heats requiring a high carbon content in the final steel. Low carbon steel produced by this process for high permeability properties gave the results shown in Table V.

TABLE V.—*Properties of Converter Steel.*

Chemical analysis: C 0.10; Si 0.18; Mn 0.34; S 0.045; and P 0.034 per cent.

Mechanical properties: Yield point, 12.5 tons per sq. in.; maximum stress, 22.7 tons per sq. in.; elongation, 37 per cent.; reduction of area, 57 per cent.

Magnetic properties:
H Values: 5, 10, 20, 40, 50, 60, 100, 150, 200.
B Values: 10,900, 13,650, 15,300, 16,500, 16,850, 17,100, 18,100, 19,000, 19,600.

For many general engineering purposes steel castings possessing a tensile strength of approximately 30 tons per sq. in. are preferred, and large quantities of this quality are produced in Great Britain by the acid side-blown converter process. The following properties, shown in Table VI, are obtained from this class of material.

TABLE VI.—*Properties of 30-ton Converter Steel.*

Chemical analysis: C 0.21; Si 28 Mn 0.90; S 0.033; and P 0.037 per cent.
Mechanical properties:

Y.P. Tons per sq. in.	M.S. Tons per sq. in.	Elong. Per cent. on 2 in.	R.A. Per cent.
17.40	30.12	33	57
15.12	30.00	32	52
15.32	30.00	32	57
15.64	30.60	33	59
17.60	31.00	33	57
16.72	30.92	32	54
17.20	30.80	33	54
15.72	31.24	33	57

The 1-in. by ¾-in. bend tests gave 120 deg. bend without fracture. The results obtained on a Wöhler machine were:—Tested at ± 15.0 tons per sq. in., unbroken at 11,740,380 revs.; tested at ± 16.0 tons per sq. in., broken at 1,979,460 revs. Short time tests at elevated temperatures gave the figures shown in Table VII.

TABLE VII.—*Strength Data at Elevated Temperatures.*

Tested at	300 deg. C.	400 deg. C.	450 deg. C.
0.05 per cent. press stress, tons per sq. in.	11.0	8.9	8.5
10 per cent. proof stress, tons per sq. in.	11.35	9.6	9.3
Yield point, tons per sq. in. ..	12.9	12.5	11.5
M.S., tons per sq. in.	34.6	29.6	25.0
E., per cent.	30	35	36
R.A., per cent.	45	55	60

Some makers prefer the following composition, C 0.25, Si 0.30, Mn 1.50, for service conditions requiring resistance to wear and abrasion, whilst others use C 0.40, Si 0.30, Mn 0.80; both of these steels are regularly made by the side-blown converter process and the following figures give an indication of the properties obtained from such steels.

TABLE VIII.—*Composition and Properties of Low- and Medium-C Steels.*

Chemical analysis: C 0.24; Si 0.26; Mn 1.47; S 0.037; and P 0.037 per cent.
Mechanical properties.

Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent. on 2 in.	R.A. Per cent.
22 32	39.12	26	44
22.40	39.38	24	43
23.20	39.04	27	50
22.80	38.40	28	52

Chemical analysis: C 0.39; Si 0.36; Mn 0.84; S 0.037; and P 0.057 per cent.
Mechanical properties:

Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent. on 2 in.	R.A. Per cent.
23.08	42.08	19	24
24.20	39.52	22	28

The 0.40 per cent. carbon type of steel is suitable for gears surface hardened by the "Shorter" process and many items of this type of casting are made annually by the converter process. Typical results, when tested by the Vickers hardness machine, gave surface hardness of 700 to 750, whilst sections showed the total depth affected to be 0.128 in., the depth of martensite being 0.076 in., whilst that of troostite was 0.052 in. The fluidity of the two steels when made by the side-blown converter process with the proper degree of temperature control is excellent and makes them well suited for the production of light thin-wall steel castings.

Other general types of carbon steels made by the same process include 0.60 per cent. C, and 0.45 C and 1.5 per cent. Mn steels.

Alloy Steels

Nickel and molybdenum steels can be made easily by this process, the alloys (nickel and ferro-molybdenum) being added to the metal before the blow commences. In the case of chrome and vanadium steels, the alloys are added to the bath after slagging and after deoxidation. Austenitic manganese steel can be made by adding molten ferro-manganese to the bath of killed carbon steel, any adjustments required to keep the carbon-manganese ratio being made with low-carbon ferro-manganese. The following physical properties of low alloy content and of austenitic manganese steel castings made by the side-blown converter are given to indicate the quality of the product.

Nickel Steel (3 per cent. Nickel)

Chemical Analysis: C 0.20, Si 0.35, Mn 0.80, Ni 3.00, S 0.035, and P 0.040. per cent.

Mechanical Properties: Yield point, 24.0 tons; maximum stress, 36.4 tons; El., 27 per cent.; R.A., 47 per cent.

The fluidity of this steel is extremely high and is well suited for running thin sections.

Molybdenum Steels

Chemical analysis: C 0.22, Si 0.35, Mn 0.76, S 0.037, P 0.042, Mo 0.64 per cent.

Mechanical Properties: Tested at:	Room temp.	300 deg. C.	400 deg. C.	450 deg. C.	500 deg. C.	550 deg. C.
Limit of proportionality ..	19.5	11	10	9	9	6.5
Yield point	21.2 to 24.8	20.75	18	18	17.5	16.75
Max. stress	33.0 to 34.8	41.25	34.25	33.75	29.75	25.25
El. per cent.	30 to 31.5	14.5	24.75	31.75	34.5	36
R.A. per cent.	52 to 57	24	40.25	54.75	69	77.75

The above tests at elevated temperatures were short-time tensile tests.

Chrome-Molybdenum Steels

Chemical analysis: C 0.25, Si 0.36, Mn 0.96, S 0.010, Cr 1.05, Mo 0.46 per cent.

Attention is drawn to the very low sulphur content in this steel, the heat being doubly desulphurised. Original cupola metal, 0.068 per cent. S; after first desulphurising, 0.025 per cent. S; and after second treatment, 0.014 per cent. S.

Mechanical properties: W.Q. deg. C.	T. deg. C.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent.	R.A. Per cent.
900	450	49.52	72.72	9.5	33
900	500	43.72	66.76	13	36
900	550	43.64	62.56	15	47

Copper-Manganese-Molybdenum Steels

Chemical analysis: C 0.24, Si 0.52, Mn 1.44, S 0.041, P 0.045, Mo 0.39, Cu 0.62 per cent.

Mechanical properties: W.Q. deg. C.	T. deg. C.	Y.P. Tons per sq. in.	M.S. Tons per sq. in.	E. Per cent.	R.A. Per cent.
900	580	50.36(*a*)	57.52	14	30
900	650	36.04(*b*)	45.16	24	52
		Impacts (*a*) 40, 41, 41 (*b*) 49, 47, 55			

This steel was used to produce castings 0.375 in. thick and little trouble was encountered due to short run edges, etc., the steel being quite fluid.

Austenitic Manganese Steel

Chemical analysis: C. Per cent.	Si. Per cent.	Mn. Per cent.	S. Per cent.	P. Per cent.	M.S. Tons per sq. in.	E. Per cent.	R.A. Per cent.
1.02	0.82	13.75	0.020	0.068	59.3	64	38
1.02	1.09	13.10	0.020	0.069	58.06	52	41
1.16	0.78	13.75	0.020	0.076	58.38	59	43

The addition of chromium to this steel slightly increases the hardness and reduces the tendency of the steel to "spread" or "flow" in service.

Chemical analysis: C 1.20, Si 0.83, Mn 12.8, S 0.020, P 0.066, Cr 1.28 per cent.

Mechanical properties: M.S. Tons per sq. in.	E. Per cent.	R.A. Per cent.
60.34	55.5	Unbroken
61.32	62	42
62.34	62	41

The foregoing figures are intended to demonstrate the excellent properties of the steel that can be made by this process. Statistical studies of the test results taken over a long period of time have shown that those of the process compare very favourably with those of any other used for steel casting production and of similar chemical analysis. From the steelfounder's point of view, the process is a very flexible one and gives hot fluid steel in suitable quantities (depending, of course, upon plant facilities) and at regular intervals. This makes the process an ideal one for the mass production of green sand steel castings and it is the Author's considered view that, with the aid of the new technical control methods and instruments, the process will regain its former popularity. The real test, of course, will be the quality of castings made, and their subsequent behaviour in service.

Future Developments

The very high quality of product which has been produced during recent years, together with the publication of recent technical investigations,[3] has become known among all steelfounders in the United Kingdom, and it is felt that rapid and large-scale developments will be seen in this country. It is known that consideration has been given to the conversion of a large bottom-blown Bessemer plant to one of equal capacity of side-blown units. The excellent figures for gas content which have been obtained and quoted in this Paper, and confirmed by other workers, have convinced bulk steel producers of the possibilities in the side-blown operation. In Germany during the recent war, 25-ton basic side-blown converters were in use at the Mannesmann Works at Huckingen and these proved very successful, and steel was made to a regular specification of 0.008 per cent. nitrogen. The steel made from the side-blown converter is hotter than that from the bottom-blown vessels.[4]

Liquid steel can be produced at as low a cost by the side-blown converter process in plants of modern construction and with the necessary degree of technical control as that by any other steel-making process. It is, therefore, safe to predict a very good future for the process, for the production of steel for castings, and possibly for ingot production. It is felt that development will follow (*a*) the increased use of superheated low-silicon metal or at least a greatly increased use of lower silicon metal than is at present used; (*b*) more control over desulphurisation and possibly of dephosphorisation; (*c*) a general use of immersion pyrometer equipment as a means of accurate temperature control; (*d*) the use of photo-electric cell units for controlling the end point of the process and as an addi-

(*Continued on page* 280)

Cheapening One-off Jobs

By A. Darby

Most foundries at some time or other are expected to produce what is known as a " one off " at the lowest possible cost, and the object of this Paper is to suggest a few ideas for reducing the ever expensive item of pattern making. With a close liaison between moulder and patternmaker, the value of which is often underestimated in many foundries, and the use by the patternmaker of one of the many substances that can be used to make the pattern, the ultimate cost of the casting can be reduced to a minimum.

Should the style of casting required be suitable, the cheapest method is by using sand or loam as the material for the pattern, and the application of this method is wide and varied, a few examples of which will suffice. In the case of a round job, the core is turned or struck up in loam, then dried, and a coating of loam or sand added, equal to the thickness of metal required, wood flanges, brackets or other additions are fixed on by patternmaker, a mould is made, after which the added sand and other additions are removed and the original core is used in the mould. This method can also be used to produce complex shaped pipes up to large diameters by casting a pair of iron plates the shape of which are the same as the outline of the casting plus a two inch margin all round, the margin being used to give a bearing for strickles to strike a half round or other shaped core on each plate; the cores are dried on the iron plates and loam added equal to the thickness of metal by use of the original strickles which have been enlarged by patternmaker cutting a thickness off all round the strickle equal to the metal thickness, wood flanges and other additions are fixed on to the two half sand patterns and procedure is then as in previous example.

Centrifugal Castings

A further application of the same principle has been found successful in the production of more complicated castings, and has resulted in bronze castings of centrifugal casings down to $\frac{5}{16}$ of an inch thick being produced without considerable cost of the necessary core-boxes. A skeleton pattern is made by pattern shop, that is, a pattern having the outside casting shapes at various points and carrying normal core-prints, this pattern is completed by filling in between the sections with sand and a mould is made off the completed pattern. The mould is stoved and then lined up with pieces of green sand core of an equal thickness to the metal of the casting, next, the mould is lined with waxed paper and the cores made in the mould during which operation the patternmaker superintends the incorporation of any internal pieces which have already been made in pattern shop in wood. The whole is then again stoved, after which the cores are taken out, the metal thickness removed along with any internal wood pieces which have survived the heat of the oven, we then have mould cores and an absolute guarantee of metal thickness.

In the case of large castings with flat backs such as tables or bases whose shape is symmetrical, that is, either round, square, rectangular or hexagonal, etc., a useful method is to make a quarter or suitable section of pattern and place in a frame core-box about 6 inches deeper than the pattern, and a similar amount larger than the outside edges of the pattern, the required numbers of cores are made, *e.g.*, four for a square job, during the making runners and risers are incorporated. After the cores have been stoved they are assembled on a flat bottom part mould which has been made and also stoved, the whole is then rammed round with green sand either in the floor or in an odd box-part, thus producing what is virtually a dry sand mould with the patternmaking costs cut by a considerable margin.

Should a large round job be called for, such as a flange, gland or similar type of casting, quite a cheap job can be produced by the peg and segment method which allows green sand to be used instead of using loam sweeps and entailing the added cost of a loam mould. A wooden peg is rammed in the centre of a sufficiently deep bottom part moulding box, pattern shop supplies a short segment piece of wood of similar section to the casting; this segment is attached to a wooden arm in which is bored a hole of similar diameter to the peg in mould. The segment can now be rotated on the peg and the moulder rams a portion of the mould moves the segment round the necessary number of times to complete the circle, a flat top part is rammed up separately and thus the mould is completed.

Drawing a pattern lengthwise when making long lathe beds, can be effectively applied in the making of odd cylinders, troughs, etc., as is known this method only requires a pattern just over half the length of the finished casting, the pattern is rammed up its full length then drawn along to the length of the casting, which is marked on a staff for the moulder's use. The reason for making the pattern more than half the finished length is to ensure that the one end of the pattern has a definite location in the part of the mould already rammed up.

The methods already outlined entail a small extra cost in the moulding operation for the foundry, but this is more than covered by the cost saving in the pattern shop.

*Prize-winning entry for a short Paper competition, organised by the Birmingham, Coventry and West Midlands branch of the Institute of British Foundrymen.

Carbon and Alloy Steels

(*Continued from page* 179)

tional means of temperature control; (*e*) the use of better shaped converters as a means of reducing metal losses due to projections, and (*f*) a better appreciation of the high quality of steel that can be produced by the process if proper precautions are taken.

REFERENCES

1 " Developments in the Design and Use of Side Blown Converter plants." (P. C. Fassotte, *J.I. & S.I.*, 1944, Pt. II.

2 " The Control of Tropenas Converter Blowing by a Direct Vision Spectroscope." S. T. Jazwinski, *J.I. & S.I.*, 1945, Pt. II.

3 *J.I. & S.I.*, Vol. 155, Pts. I and II.

4 " German Iron and Steel Industry, Ruhr and Salzgitter Areas. Combined Intelligence Objectives Sub-Committee, Item No. 21. File XXXII—119. H.M. Stationery Office.

Zinc Corporation's Future Policy

Confidence in World Level of Prices

Although the official ceiling price of lead in Australia was maintained at £A.22 per ton, which showed an increasing margin below export prices, the prices paid by the British Government continued to be less than those ruling elsewhere and much below the price charged to U.K. consumers, states Mr. John Govett, chairman of the Zinc Corporation, Limited, in his review submitted with the report. This, he says, has undoubtedly been a disturbing element in the market and he urges that the position should be corrected.

The price realised by the company for lead in 1946 was £37 1s. 3d. per ton, f.o.b. Port Pirie, as compared with the £25 4s. 3d. per ton for 1945. For the first six months of the current year the price obtained has risen to £61 18s. 6d.

Mr. Govett says that the higher range of metal prices so far experienced this year justifies the board in expecting the profits for the current 12 months to be in advance of those realised for 1946, notwithstanding the considerable increase in the royalty charge and overall taxation which gross profits will attract.

The directors' policy and programme of operations are definitely not built upon the full maintenance of the current or recent level of metal prices. Quite outside the conditions of supply and demand which normally govern prices, there are other major factors affecting, or soon likely to affect, commodity markets which may have a not unappreciable influence on metal values in the not distant future. Of these, Mr. Govett says, the most important is probably the effort to bring about reasonable relations of the world's leading currencies, and in particular to protect sterling. The board did not intend to speculate on either the extent of the probable adjustments or when they might take place. They were confident in a world level of prices which would fully justify the company's expansion programme undertaken.

British Aluminium Company's Debenture Redemption

The British Aluminium Company, Limited, is to redeem the whole of its outstanding £3,135,559 4 per cent. mortgage debenture stock on December 31 next at 104 per cent. and to issue £3,500,000 3 per cent. mortgage debentures redeemable over 40 years. Existing holders are to be invited to convert into the new stock at 100½ per cent. Treasury consent has been obtained and Hambros Bank has agreed to underwrite the issue.

Holders accepting the offer will receive on January 1 a full six months' interest, together with a cash payment of £3 10s. per cent., being the difference between the redemption price and the issue price of the new stock. The offer to exchange into the new stock will expire on July 28.

THE ARGENTINE CENTRAL BANK has suspended permits for the import of textile machinery both for spinning and weaving.

Industry May Face Transport Crisis

Dearth of Railway Wagons

Speaking at his fortnightly Press conference last week on the economic situation, Mr. Herbert Morrison, Lord President of the Council, warned the country that the dearth of railway wagons involved a risk next winter of "a certain measure of slowing down in our basic industrial activity and in building." Goods traffic measured in ton-miles to-day was higher than before the war, he said. The number of wagons was about the same, but whereas before the war about 3 per cent. of them were under repair at any time, the figure now was over 12 per cent. The difference meant that 150,000 wagons, out of our total of about 1,250,000, were lost for working purposes at any given time.

So far as could be estimated, if we were spared an abnormally severe winter and if some improvement could be made in the speed of turn-round of trucks, then the railways would be in a position to move coal supplies as necessary; but there would be some shortage of wagons for other purposes. It might be a shortage of about 10 per cent., but it could be worse in particular districts at particular times. Transport of food was least likely to be affected. The commodities most likely to suffer were heavy goods like bricks, cement, iron ore, and steel.

The Lord President said that the provisional total of exports for June was £93,100,000—the highest monthly figure by value since December, 1920.

June Iron and Steel Output

Production of steel ingots and castings in the second quarter of 1947 was at an annual rate of 12,694,000 tons, compared with 11,231,000 tons in the first quarter and 13,111,000 tons in April-June, 1946. Last month production was appreciably higher than in June, 1946, when operations were curtailed by the Whitsun and V-day holidays. The higher rate of output in recent months has been achieved only at the cost of continued withdrawals from stocks of pig-iron and steelmaking materials. The maintenance or increase of the level of steel production depends on the availability of increased supplies of coal.

	Pig-iron.		Steel ingots and castings.	
	Weekly average.	Annual rate.	Weekly average.	Annual rate.
	Tons.	Tons.	Tons.	Tons.
1947—1st quarter ..	134,400	6,989,000	216,000	11,231,000
April	139,200	7,238,000	236,400	12,294,000
May	141,900	7,378,000	243,900	12,684,000
June	144,300	7,501,000	254,000	13,206,000
2nd quarter ..	141,600	7,363,000	244,100	12,694,000
1946—1st quarter ..	145,500	7,566,000	242,600	12,617,000
April	148,700	7,732,000	252,100	13,111,000
May	151,200	7,860,000	261,900	13,619,000
June	151,500	7,878,000	239,900	12,475,000
2nd quarter ..	150,500	7,827,000	252,100	13,111,000

Personal

MR. H. C. MALLETT has been elected a director of Associated Clay Industries, Limited.

MR. LEO RUSSELL has been appointed Director of the British Institute of Management.

MR. GREGOR GRANT has retired from the board of P. & W. Maclellan, Limited, Glasgow.

MR. W. R. VERDON SMITH and MR. C. H. DAVY have been appointed directors of Babcock & Wilcox, Limited.

MR. C. COOKSON and COL. A. J. FOSTER have resigned from the board of Goodlass Wall & Lead Industries, Limited.

DR. J. W. BONDI has been appointed a director of British Oil Engines (Export), Limited, the export subsidiary of Associated British Oil Engines, Limited.

MR. G. T. HARRIS has been appointed research manager to William Jessop & Sons, Limited, and J. J. Saville & Company, Limited, under the present director of research, Mr. D. A. Oliver.

MR. JOHN BOLTON has resigned his position as assistant secretary of the Institute of British Foundrymen. He is joining the staff of the Institute of Cost and Works Accountants in October.

MR. R. G. HODGSON has resigned from the board of Whessoe, Limited, Darlington, on account of advancing years. He joined the board as managing director in 1925 and held the position until 1935.

MR. W. G. WRIGHT, who has been with J. P. Hall & Sons, Limited, pump manufacturers, of Peterborough, for 20 years, has been appointed a director of the company. He was appointed works manager some time ago.

MR. D. E. BUNCE has been appointed secretary of James Booth & Company, Limited, manufacturers of non-ferrous tubes, etc., of Birmingham, on the retirement of MR. R. FRANKLIN, who will take over the position of comptroller.

MR. HUGH ARMITAGE has resigned his position as chairman of the Hoffmann Manufacturing Company, Limited, due to business reasons. He retains his seat on the board. MR. J. W. GARTON, a director of the company, has been elected chairman.

MR. GEORGE SPENCER, foreman of the scrap yard of Thos. Firth & John Brown, Limited, Sheffield, is to retire shortly. He joined the firm of John Brown, steel manufacturers, over 57 years ago, being transferred to the scrap yard on the amalgamation with Thomas Firth's. Mr. Spencer is 73 years of age.

MR. V. R. WEBB, managing director of Thomas Robinson & Son Pty., Limited, of Sydney, is in Britain in connection with machinery and construction of silos, flour and rice mills, grain-handling and woodworking machinery. His address while in this country will be c/o Thomas Robinson & Son, Limited, Rochdale.

MR. H. H. GALE, of Ashmore, Benson, Pease & Company, Limited, has been elected chairman of the newly-formed Tees-side branch of the Purchasing Officers' Association. The hon. treasurer is MR. C. N. BEST, of Dorman, Long & Company, Limited, and the secretary, MR. K. MCGRATH, of British Titan Products Company, Limited.

MR. WANG MAN SUN, a British Council Chinese scholar, has been awarded the Brunton medal and £25 premium offered annually by Sheffield University to each of the two students who present the best original researches on a metallurgical subject during the session. Mr. Wang Man Sun, who became a British Council scholar in January, 1945, has recently had the D.Phil. degree conferred upon him. He is now gaining practical experience in metallurgy as a student at the Sheffield works of the English Steel Corporation, Limited.

MR. A. POOLE, having passed the retiring age, has resigned from the position of chief engineer of the engineering department of the Davy & United Engineering Company, Limited. He is remaining with the company as whole-time consulting engineer. Mr. Poole has been with the company for 40 years and has been chief engineer for the last 16 years. The following promotions in the engineering department have been announced:—MR. W. W. FRANKLIN, to chief engineer; MR. W. CRAIG, to assistant chief engineer in charge of sectional rolling mill design, including blooming and slabbing mills; MR. W. H. GOODLAD to assistant chief engineer in charge of flat rolling mill design, including auxiliary equipment, and MR. J. G. FRITH, to assistant chief engineer in charge of the design of hydraulic machinery. MR. R. BALLANTYNE has been appointed drawing office manager.

Wills

GRANT, J. H., of Bournemouth, a director of J. H. Grant, Limited, metal merchants, of Oxford ...	£26,434
MORISON, THOMAS, of Newcastle-upon-Tyne, a director of Swan, Hunter & Wigham Richardson, Limited, Barclay, Curle & Company, Limited, Sigmund Pumps, Limited, and Glasgow Iron & Steel Company, Limited	£64,012

Ironfounders and Nationalisation

It is expected that the Government plan for the nationalisation of the iron and steel industry will shortly be issued, but they have reason to believe that their section of the industry will not come directly within the scheme, says Mr. James Shaw, chairman of Allied Ironfounders, Limited, in his statement accompanying the accounts. They must realise, however, if their sources of supply, their means of transport, and the buyers of their products become publicly owned, that there may be changes in their system of trading, the extent and effect of which is difficult to foresee, he continued. There were grounds, however, for grave apprehension from the national aspect on the score of the possible dislocation of a group of integrated industries if any scheme was imposed without full examination of the many complex issues. "The figures and reports before you to-day," he comments, "represent a highwater mark of achievement in the history of your company since its formation 18 years ago."

Non-ferrous Scrap Metal Prices

Revised List of Quotations

The following prices of non-ferrous scrap metals have been announced by the Ministry of Supply. The prices are for scrap metal at Ministry of Supply depots at which the Minister is prepared to effect a sale to a buyer subject to having sufficient material of that particular quantity available at a convenient depot at any particular time. The list refers to delivery within the current and next three calendar months, but is published without prejudice of commitment. Without notice the schedule of materials may be amended in the light of changing circumstances, and prices may be altered in accordance with market conditions, production costs, and other factors. Publication of the prices does not constitute an offer of sale. The following prices are per ton, ex-works:—

Copper—Clean, untinned, cut up, £124; shell-band scrap (other than turnings), £124; copper turnings (including shell-band turnings), £112.

Zinc—Zinc scrap, £58 10s.

Zinc Alloy—Zinc alloy die-cast scrap, £65.

Brass—S.A.A. webbing, £102 10s.; defective cups and cases, £101 10s.; cut-offs and trimmings, £96; ruffled and/or mechanically treated cases, £98 10s.; turnings, loose, £88; Q.F. webbing, £103 10s.; Q.F. cut-offs and trimmings, £101 10s.; Q.F. defective cups and cases, £103 10s.; Q.F. turnings, £89; other 70/30 process and manufacturing scrap, £100; 60/40 rod swarf, £80 10s.; process and manufacturing scrap containing over 62 per cent. and up to 68 per cent. copper, £94 10s.; broken down fuse scrap 60/40 and/or 60/40 brass rod of 1¼ in. dia. and over, £91; 90/10 gilding metal webbing, £116; 90/10 gilding metal defective cups and envelopes before filling, £113 10s.

Scrap gilding metal bullet envelopes (max. antimonial lead content 4 per cent.), £100; scrap cupro-nickel bullet envelopes (max. antimonial lead content 0.08 per cent.), £116; brass cartridge metal strip, £104 10s.

Piston Ring Companies' Merger

The directors of Associated Engineering Holdings, Limited, announce that holders of more than 90 per cent. of each class of capital of the British Piston Ring Company, Limited, Hepworth & Grandage, Limited, and Wellworthy Piston Rings, Limited, have accepted the offer to exchange their stock and shares for shares of the holding company.

Mr. A. H. Jarrard, chairman of the British Piston Ring Company, has been elected as chairman of the merger company. The other directors are Mr. V. W. Oubridge and Mr. A. W. Blunt (British Piston Ring Company), Mr. G. R. Hall-Caine, Mr. W. Hepworth, and Mr. E. Hepworth (Hepworth & Grandage), and Mr. N. W. Howlett, Mr. G. Fisher, and Mr. A. J. Woolcott (Wellworthy Piston Rings). Interim dividends on the stock and shares of the operating companies have been declared in accordance with the offer. The transfers to the holding company will be "ex" these dividends.

Obituary

MR. JOHN M'NAUGHTON, manager of the engineering department of the Ailsa Shipbuilding Company, Limited, Troon, died recently.

MR. WILLIAM CHARLES WELLESLEY WEAVER, chairman and until lately managing director of Waygood-Otis, Limited, died suddenly on July 11.

MR. EDWIN JAMES HALL, who died on July 9, was managing director of Hall & Hall, Limited, manufacturers of steam and hydraulic packings, etc., of Hampton, Middlesex.

MR. JAMES SHANKS, a director of Alexander Shanks & Son, Limited, engineers and ironfounders, etc., of Arbroath, has died at the age of 85. He had been associated with the business for 67 years.

MR. GERALD DARWIN FLATHER, chairman and managing director of W. T. Flather, Limited, steel manufacturers, of Sheffield, until the end of 1946, when he retired from active participation in the company, has died at the age of 74. He was also a director of Lead Pipes, Limited, Elland, Yorks.

MR. CHARLES THOMAS BLACKLOCK, managing director of the Clayton Dewandre Company, Limited, motor and general engineers, etc., of Lincoln, and chairman of Gyral Gears, Limited, Wandsworth, London, S.W.18, died on July 11. He had earlier attended a dinner following which a number of people were taken ill with suspected food poisoning. A verdict of "Misadventure" was returned at the inquest on the body of Mr. Blacklock.

MR. GEORGE ERNEST GORE, general manager of the Teesdale Ironworks of Head, Wrightson & Company, Limited, who has died at the age of 66, had a distinguished career as an engineer. He received his early training with Francis Morton & Company, Limited, manufacturers of structural steelwork, girders, etc., of Liverpool, and subsequently spent 37 years on Teesside. He was first appointed works manager for Head, Wrightson & Company in 1919, and was afterwards promoted to be general manager.

Training of Electrical Engineers

A report on the training of professional electrical engineers, published by the Institution of Electrical Engineers, recommends two types of apprenticeship—graduate apprenticeships, lasting two years, for those obtaining their technical education by means of full-time courses at universities, and student apprenticeships, lasting four years, for those attending part-time courses at technical colleges. The report is part of a general survey by a joint committee set up two years ago under the chairmanship of Sir Arthur Fleming to study the overall problems of training in the electrical industry. The recommendations for the training of technicians, as distinct from engineers, will be issued later.

OVER 200 WORKERS from the Ketley and Coalbrookdale works of Allied Ironfounders, Limited, recently joined in an outing to Blackpool.

News in Brief

PRODUCTION HAS COMMENCED at a new factory on the Bede Estate, Jarrow, of George Wilson Gas Meters, Limited.

A PARTY OF 18 Norwegian engineering students have been visiting factories in this country during a two-week tour arranged by the British Council.

IT IS REPORTED that a shipbuilding yard, to construct ocean-going vessels of 10,000 to 15,000 tons, is to be established at Karachi, and that John Brown & Company, Limited, Clydebank, have promised to give technical aid.

MEMBERS OF THE North London branch of the Institute of Welding were the guests of K. & L. Steelfounders & Engineers, Limited, Coburn Works, Letchworth, on July 1 and 8, through the courtesy of Mr. F. W. Rowe.

CRAFTSMAN JAMES RUSSELL, R.E.M.E., of Motherwell, was in charge of the erection of the first British Army foundry between Haifa and Acre. He is at present home on leave. The foundry does maintenance work for Army transport.

WILD-BARFIELD ELECTRIC FURNACES, LIMITED, Watford, have received an order for the supply of heat-treatment equipment for the aero-engine factory of the Turk Hava Kurumu, Ankara, which is to manufacture the De Havilland Gypsy engine.

IN HIS SPEECH at last week's annual meeting of Sheffield Steel Products, Limited, Capt. W. M. Hungerford Pollen, chairman, said that it was proposed to subdivide the issued ordinary stock into 5s. units. A special meeting would be called to authorise this action.

THE LAST SHIP on the stocks at the Walker-on-Tyne Yard of the Shipbuilding Corporation, Limited, is to be launched next month; no further orders are being placed with the yard. The Board of Trade has announced that the shipyard site will in future be used for repairing wagons.

THE INCORPORATED PLANT ENGINEERS have elected their five hundredth member—eight months after the first member. In addition to the present six branches, and those proposed at Hull and Bristol, arrangements are in hand to hold inaugural meetings in the early autumn at Peterborough, Sheffield, and Liverpool.

THE BOARD OF TRADE have been informed that as the result of improved facilities in Germany it will be possible for an increased number of business men to visit the joint U.K./U.S. zones of Germany to buy goods and services. In future all applications to visit the U.K./U.S. zones should be sent to the German Division, Board of Trade, I.C. House, Millbank, London, S.W.1, giving full details of the proposed transaction and itinerary.

STATISTICS OF trade disputes in May, published in the "Ministry of Labour Gazette," show that in the metal, engineering and shipbuilding industries 20,000 working days were lost by 4,100 workers involved in 28 stoppages during the month, compared with 12,000 working days, 3,500 workers and 37 stoppages during April. The number of working days lost in all industries during May was 181,000, compared with 240,000 in April.

THOMAS BUTLIN & COMPANY, Wellinborough, a branch of the United Steel Companies, Limited, has been bought by Morris Motors, Limited, to provide potential capacity for tractor and similar types of iron castings. Existing orders will be completed, which will fully absorb the output of the Wellingborough foundry for some considerable time. The newly acquired foundries will be operated as a department of the engines branch, Morris Motors, Limited, so that all the Morris foundries will be under one management.

BUILDING AND civil engineering work to the value of £75,000,000 will be carried out on electric power stations during the next two years, to help bridge the gap between the supply of electricity and the growing demand. In making this announcement, the Ministry of Works states that site work is in progress on 63 projects for housing plant capable of generating over 5,260,000 kw. Plans for 13 more projects, to provide 1,205,000 kw. have been approved, and site work will begin soon. A further programme for the next two years is also being prepared. The projects are for new power stations or for extensions.

REFERRING TO THE company's developments in 1946, Mr. A. E. Read, chairman of Walsall Conduits, Limited, in his statement circulated with the accounts, says that in their foundry they have installed new annealing plant, the first of its kind in the country, which is now in full production. The new plant eliminates one of the hardest and most unpleasant processes in the manufacture of malleable-iron castings, while at the same time effecting a considerable saving in production costs. Additional plant is in course of installation in the steel tube mill and when completed their tube production capacity should be approximately doubled. To ensure and improve their supplies of ceramics, the company has recently acquired the old-established business of A. G. Hackney & Company, Limited, of Stoke-on-Trent.

United Kingdom Tin Position

The Ministry of Supply has released the following figures showing the United Kingdom tin position for the month of May:—

			Ministry.	Consumers.
			Long tons.	Long tons.
TIN METAL:				
Stocks at May 1	.. .. ..		7,021	3,726
Arrivals	.. ..		—	—
Production	.. ..		2,529	—
			9,550	3,726
Deliveries:				
To U.K. consumers		2,430	—	2,430
For export	..	357	2,787	—
			—	6,156
Consumption	.. .. ..		—	2,341
Stocks at May 31	.. .. ..		6,763	3,815*
TIN ORE (Tin content):				
Stocks in U.K. at May 1	.. ..		5,924	—
Stocks in U.K. at May 31	..		5,257	—

* Calculated. Reported 3,456 tons.

THE MODERN PIG

IF YOU WANT...
clean iron, free from sand, free from sows ...uniform analysis... convenient size...easy handling... specify
STANTON MACHINE CAST PIG IRON

SPECIFICATION

WEIGHT	80-90 lbs.
Length	22 inches
Width	8½ inches
Thickness	3¾ inches

(at notch 2½ inches).

Made in our well-known

STANTON, HOLWELL & RIXONS BRANDS

THE STANTON IRONWORKS COMPANY LIMITED NEAR NOTTINGHAM

Company News

(Figures for previous year in brackets.)

Williams & Williams—Dividend of 15% (same).

John Baker & Bessemer—Additional dividend of 15%.

Crossley-Premier Engines—Dividend of 12½% (25%).

Electric Construction Company—Dividend of 12½% (same).

R. B. Pullin & Company—No interim dividend (same).

Greenwood & Batley—Final dividend of 10%, making 15% (same).

Chas. Carr—Final dividend of 75% (40%), making 125% (75%).

A. E. Jenks & Cattell—Interim dividend of 2½%, tax free (same).

Minimax—Final dividend of 12% (8%) and bonus of 5% (4%), making 25% (20%).

Mellowes & Company—Final dividend of 10% and bonus of 10%, making 30% (same).

Bristol Tramways & Carriage Company—Interim dividend of 5%, tax free (5%, less tax).

B. Elliott & Company—Final dividend of 66⅔%, making 100% on increased capital (100%).

Wellworthy Piston Rings—Dividend of 13¾% for the 11 months ended June 30 last (15% for previous year).

British Piston Ring Company—Dividend of 13¾% for the 11 months ended June 30 last (15% for previous year).

Wolverhampton Metal Company—Final dividend of 15% (same) and bonus of 10% (nil), making 40% on larger capital (30%).

British Timken—Net profit for 1946, after depreciation, taxation, etc., £83,675 (£70,360); to general reserve, £30,000; dividend of 15% (same); forward, £52,251 (£31,576).

Henry Hope & Sons—Net profit for the year ended March 29, after taxation, etc., £76,822 (£88,483); dividend of 7½% (10%); transfer to reserve, £20,000; forward, £63,497 (£46,550).

J. H. Peck & Company—Net profit for the year ended March 31, £8,052 (£6,748); dividend of 3d. per share (same) and bonus of 3d. per share (same); forward, £12,464 (£16,843).

Lovering China Clays—Profit to March 31, £28,501 (£22,762); income tax recoverable, £544 (£608); net profit, after income tax, etc., £10,792 (£6,101); debit forward, £6,123 (debit £16,914).

Geo. W. King—Net trading profit for 1946, after tax, £35,316 (£35,178); to directors' fees, £1,240 (£1,000); written off buildings, plant, etc., £8,350 (£8,353); written off patents, £962 (£849); A.R.P. expenditure, £273 (£1,625); reserve, £5,000 (same); dividend of 12½% (same); forward, £18,630 (£15,389).

Frederick Sage & Company—Net profit for the year ended September 30, after depreciation, taxation, etc., £18,476 (£19,101); to contingencies reserve, £5,000 (£10,000); dividend of 6% (8%); forward, £12,612 (£13,001).

Wallsall Conduits—Net profit for 1946, before tax, £230,707 (£127,721); to taxation, £111,543 (£54,442); general reserve, £20,000 (same); final dividend of 35%, making 55% (same) and bonus of 15% (nil); forward, £142,032 (£105,993).

Expert Tool & Case Hardening Company—Net trading profit for 1946, including dividends, £71,849 (£69,670); net balance, after directors' fees, £70,949 (£68,872); taxation and contingencies reserve, £42,881 (£48,252); general reserve, £6,500 (£3,500); dividend of 4% (same); forward, £10,654 (£7,676).

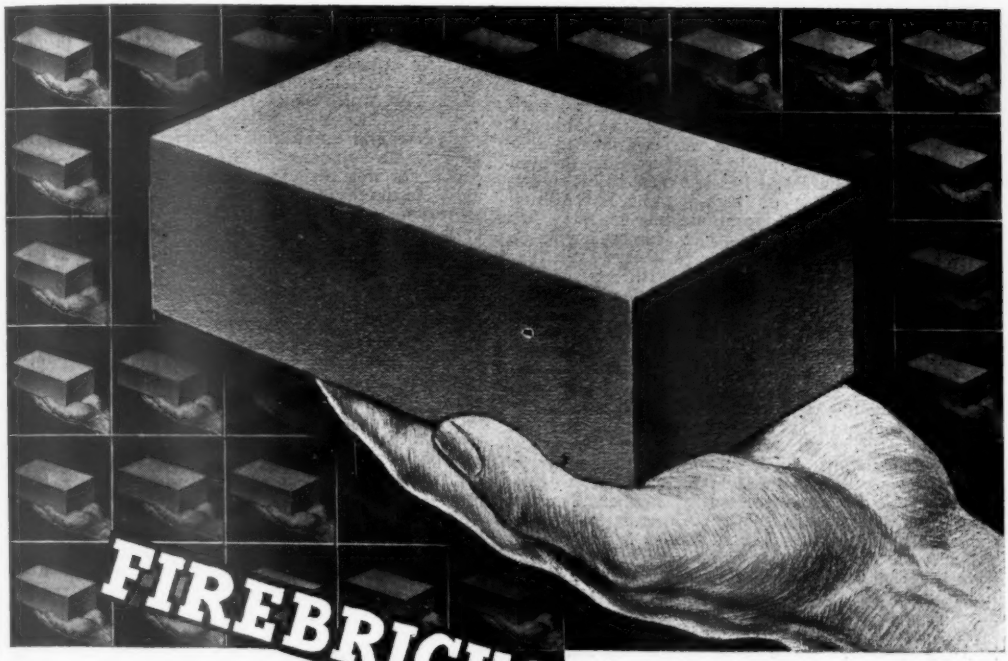
Sidney Flavel & Company—Trading loss for 1946, £12,398 (trading profit £43,904); after crediting sundry income, including £8,287 credits not relating to year's trading, £7,250 deferred repairs provided in excess of requirements and deducting depreciation, net loss, £6,590 (profit £29,651); no dividend (22½%); forward, £17,508 (£17,070).

Climax Rock Drill & Engineering Works—Net profit for 1946, after providing for depreciation and directors' remuneration, £43,433 (£35,776); E.P.T. refund, £15,000 (£26,000); to tax, £25,500 (£24,500); general reserve, £15,000 (£20,000); directors' additional remuneration, £675 (same); final dividend of 7½%, making 12½% (same); forward, £15,711 (£10,828).

The Mint, Birmingham—Total income for the year to March 31, £49,562 (£23,442, including £13,000 E.P.T. repayable); net revenue, after E.P.T., profits tax, depreciation, £31,626 (£15,083); to income tax, £17,190 (£5,883); contingencies reserve, £2,505 (nil); additional directors' fees, £1,100 (£600); dividend of 10% (same) and bonus of 5% (nil); forward, £13,308 (£11,717).

Thomas Bolton & Sons—Trading profit, dividends, etc., after tax, for the year ended March 31, £264,941 (£100,864); to depreciation, £60,000 (£50,000); directors' fees, £4,375 (£3,599); debenture interest, £17,015 (£17,230); provision for income tax on 1946-47 profits, less adjustment for previous years, £104,078 (£9,439); final dividend of 5% (same) and bonus of 2½% (nil), making 10% (7½%); general reserve, £40,000 (nil); forward, £72,422 (£68,699).

Whessoe—Trading profit for the year ended March 31, £180,856 (£216,414); interest and dividends, £469 (£1,654); transfer fees, £46 (£19); depreciation, £11,167 (£11,312); deferred repairs, nil (£15,000); directors' fees, £2,550 (£2,483); directors' commission on profits, £4,155 (£4,613); directors' other emoluments, £7,413 (£7,201); welfare schemes and pensions, £5,581 (£4,397); bonus to staff and workmen, £8,500 (same); net profit, £142,005 (£164,581); to capital issue expenses, nil (£5,733); taxation, less E.P.T. recoverable, £39,861 (£65,962); staff pensions, £4,519 (£15,000); general reserve, £25,000 (same); preference dividend, £4,400 (£1,134); final ordinary dividend of 30% (same and special bonus of 10%), making 40% (50%); forward, £63,420 (£39,195).



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GLENBOIG

Raw Material Markets

Iron and Steel

Little change can be discerned in the general position affecting pig-iron. The light foundries, although having plenty of work on hand, are experiencing difficulty in getting all the pig-iron they require, or even as much as they have had licensed to them. There is definitely a shortage of high-phosphorus pig-iron. There may be a slight improvement in the next few weeks, when another Derbyshire furnace will be operating again. On the other hand, there is still very strong pressure for basic pig-iron, and it may be that the situation will demand a higher production of this type of iron to the exclusion of foundry numbers.

The general engineering, jobbing and speciality foundries continue to be very active. They have plenty of orders on hand for high-duty castings, necessitating the best grades of pig-iron such as hematite, low- and medium-phosphorus and refined irons. These foundries, too, have had difficulty during the last few weeks in securing all the iron they want, but they are more capable of adapting themselves to the various grades of pig-iron than the light foundries, which cannot use with the same success irons other than the high-phosphorus grades. The position in respect to the supply of refined pig-iron should improve after the end of this month, when all export orders will have been finished. The makers, however, have heavy order-books for home consumption, and some are already booked provisionally until September.

Very much the same position arises in regard to hematite pig-iron. Some furnaces are not sellers at all at the moment, while others cannot offer delivery until the end of this period. Unfortunately, there is no better news in respect of scrap. Supplies of both cast-iron and steel scrap are definitely short, and foundries are somewhat concerned at the position generally to-day. Large quantities of scrap are more than ever necessary to-day, because of the shortage of pig-iron.

Coke supplies are flowing somewhat more freely than they were. The increased tonnages recently permitted will be a considerable help. At the moment, there is no wagon shortage interfering with supplies, and, as far as it is possible to see, tonnages that have been despatched are well up to the allocated quantities. Foundries are taking supplies of limestone and ganister not only for current use, but for emergency stocks. The engineering foundries are getting prompt supplies of ferro-alloys.

Improved tonnages of semis from abroad have been extremely welcome, but there is no likelihood of the improvement being maintained indefinitely. Negotiations are still going on by the Control for the acquisition of larger supplies of billets, sheet bars, etc., from abroad, but the trade as yet do not know the results. In the meantime, the home makers are being severely pressed by consumers. During the last two months supplies have improved to some extent, but there does not appear to be any early prospect of the re-rollers having sufficient steel from home production and imports to enable them to keep their mills at maximum production. They are very heavily booked for light angles, strip and small bars, so much so that the state of their order-books would warrant full-time working for the next six months. Recently, the supplies of electrical steel which have been acquired have been of some assistance to certain re-rollers, but this steel is not of general application. Owing to the lower outputs at the rolling mills the quantities allocated for export for this period have been cut down considerably. In the meantime, steelworks have no difficulty at all in finding immediate outlets for defective sheet bars or billets, crops and the like.

Priority classes are claiming a considerable percentage of the output of sections, joists and plates, and all steelworks have orders on hand sufficient to cover their requirements for many months to come. Structural engineers, who are not engaged on priority jobs, are in great difficulty; in fact, some of them are unable to secure sufficient sections, joists or plates to keep all their men employed, and many contracts are considerably behind. It is reported that it will take some months to make any appreciable headway into the requirements of the priority classes, which have increased in recent weeks. In the meantime, collieries are taking considerable quantities of steel for maintenance and extension work. Largely their quotas are taken up with rails, roofing bars, arches and props, but they have other urgent requirements in tub plates, etc. In some areas additional tonnages have been granted to the collieries in view of developments which are taking place.

Non-ferrous Metals

The United States production of crude copper in June is given by the American Copper Institute as being 81,854 short tons, compared with 90,556 tons in May. Refined copper, too, showed a decrease at 98,738 tons, compared with 108,464 tons for the previous month. Stocks of refined copper at the half-year were given as 76,629 tons, against 81,643 tons a month earlier.

In the United Kingdom, although the official maximum price has been reduced by £5, little satisfaction has been given to copper consumers. The price remains much in excess of world prices.

Pig-iron and Scrap Licences for New Foundries

The Iron and Steel Board wishes it to be known that, in view of the necessity to make the most efficient use of available supplies needed for the production of iron castings, the Board closely examines applications for licences for the purchase of pig-iron and scrap, and may be compelled to withhold such licence in the case of ironfoundries not already in operation unless the Board's prior approval of the undertaking has been obtained.

Individuals or companies contemplating entering the ironfoundry industry are accordingly advised to communicate with the Secretary of the Iron and Steel Board, Bush House, South-West Wing, Strand, London, W.C.2.